Source: SMC Chairman Karl Loew
Date: 4 September 2002
Place: Darmstadt, Germany

Summary of the Activities within the SEAMCAT MoU 1997-2002

1 Introduction

SEAMCAT (Spectrum Engineering Advanced Monte-Carlo Analysis Tool) is the implementation of a Monte-Carlo based radio simulation model developed by the group of CEPT Administrations, ETSI members and international scientific bodies. This model is now widely introduced and used within CEPT and ITU-R.

SEAMCAT is public object code software distributed by the CEPT European Radiocommunications Office (ERO), Copenhagen. The newest version can be downloaded from *http://www.ero.dk*.

For financing of this project a "Memorandum of Understanding (MoU) on Development of Monte Carlo Simulation Tool" was set up in 1997. The project was controlled by the SEAMCAT Management Committee (SMC) and ERO. 26 meetings were held over 5 years and two major SEAMCAT versions were developed in that period: the latest version is 2.0.10c published in September 2002.

In the following a summary of the project history, information on the current status and version of SEAMCAT, the involvement of ERO and on the continuation of the project in the future are given.

2 Project history

1996	First specifications for an algorithms for compatibility investigation between different services by CEPT/ERC/WGSE Project Team 21
4 September 1997	Establishment of the MoU on Development of Monte Carlo Simulation Tool Members: Administrations, Operators, manufacturer and ERO (final list of members see Annex 1) Termination: 4 September 2002
October 1997	First Meeting of a Provisional Management Committee (MC), later called SEAMCAT MC (SMC) Chairman: Mr. Mohan Dhamrait, Radio Agency, UK
April 1998	Final decision of the software house: Cril
May 1998	Final specification of the algorithms by CEPT/ERC/WGSE
August 1998	Creation of the name SEAMCAT for "Spectrum Engineering Advanced Monte Carlo Analysis Tool"
December 1998	SEAMCAT logo
July 1999	First commercial tool published

December 1999	Validation of this tool by SMC experts and free circulation of the software (version 1.0.8)
January 2000	Introduction of SEAMCAT in ITU-R
January 2001	Decision on the upgrade of SEAMCAT (Phase 1+)
March 2001	Change of the chairmanship in SMC New Chairman: Karl Loew, Deutsche Telekom, D
June 2001	Free training of the use of SEAMCAT for MoU members at ERO
December 2001	Upgraded version 2.0.8 of SEAMCAT developed by Cril
February 2002	Finalisation of the trademark registration process (list of countries see Annex 2)
4 September 2002	Termination of the MoU: latest version of SEAMCAT: 2.0.10c Transfer of the rights and responsibility on SEAMCAT to ERO Technical support will be provided by CEPT/ECC/WGSE Project Team 21
October 2002	planned training on the upgraded SEAMCAT version for MoU and SE members

3 Software tool SEAMCAT

Description of the model

The SEAMCAT® tool is a software product based on the Monte Carlo simulation method, which permits statistical modelling of different radio interference situations. It is a public domain software distributed by the European Radiocommunications Office (ERO) (http:\\www.ero.dk).

The radio spectrum, since it is a limited resource, can only be used optimally if radio compatibility is ensured between different radio systems located in the same or adjacent frequency ranges. When several systems, possibly employing different technologies, are operating in the same or neighbouring geographical areas and are using frequency bands close to one another, the compatibility between different systems has to be studied. There are many radio scenarios where traditional analytical methods can not offer any satisfactory solution.

SEAMCAT is a flexible tool for analysis of a variety of compatibility and sharing scenarios, and it offers some particularly important features:

- *quantification of interference levels*
  The level of interference between different radio systems is expressed in terms of a probability that the reception capability of the receiver under consideration is impaired by the presence of an interferer.
- *consideration of spatial and temporal distributions of the received signals*
  This is helpful in developing appropriate frequency planning arrangements or necessary limits for transmitter/receiver parameters.
- *SEAMCAT can address any interference scenario regardless of the type of victim and interfering radio systems.*

Applications

Some examples of already completed studies using the SEAMCAT are:

CEPT SE7:	Compatibility study between digital PMR (TETRA) and GSM at 915 MHz
CEPT SE19:	Sharing study between FS and FSS
CEPT SE24:	Sharing study between Short Range Devices (Bluetooth) and RLANs in the ISM band at 2.4 GHz
ITU-R TG8/1	Compatibility study for IMT-2000 and GSM-1900 around 1.9 GHz

Some examples of on going studies using the SEAMCAT are:

CEPT SE7:	Compatibility study between digital PMR (TETRA) and FM at 412 MHz
CEPT SE27:	Compatibility study between digital PMR and Tactical Radio Relay (TRR)
Motorola:	Compatibility study for Ultra Wide-Band (UWB) systems and other radio systems.

Presentations

The simulation methodology and the tool itself were presented at various occasions in ITU-R Study Group 1, ETSI TC ERM, Vienna Agreement, CEPT Radio Conference and WGSE, Wroclaw EMC Symposium, IEEE VTC, etc.

Latest SEAMCAT version: 2.0.10c issued 2 September 2002

Supplementary documentation

- ERC Report 68 (Rev. June 2002):
  Monte Carlo simulation methodology for the use in sharing and compatibility studies between different radio services or systems
- ITU-R Report SM.2028-1 (Rev. July 2002):
  Monte Carlo simulation methodology for the use in sharing and compatibility studies between different radio services or systems
- USER DOCUMENTATION (Revised August 2002) to support use of SEAMCAT
- Training documentation for beginners
- On-line help available during simulation
- For MoU members only: source code and technical documentation by Cril

4 Future of SEAMCAT

Continuation of the SEAMCAT project

The SEAMCAT project will continue under the overall administration of ERO. The overall maintenance and long-term technical development of the SEAMCAT would be ensured by the following split of the current MoU responsibilities into two parts:

- *Technical group* responsible for technical support, maintenance and promotion of SEAMCAT Phase 1+ and for the evolution to SEAMCAT Phase II.
  WG SE has decided, and endorsed by the ECC in its June meeting, that these activities will be performed within SE21 and should be open for all interested parties including administration, industry, operators, universities, etc..
- *Administration by ERO*
  This includes all daily maintenance and user support tasks, financing issues, trademark, IT-support, contracts with third parties (e.g. software implementation by a software house), etc..

Suggestions of further extensions of the functions implemented in SEAMCAT

Some initial suggestions on new functionalities and some areas of improvement gained from users for a future SEAMCAT version are listed in Annex 3.

5 Acknowledgement

The SMC chairman thanks all participants in the project for their active co-operation in the development of the algorithms, testing of the tool and promotion of SEAMCAT. The SMC chairman appreciates the huge engagement of the former SMC chairman Mr. Mohan Dhamrait to develop a realistic computer tool for a more efficient use of the radio spectrum and of the excellent administrative support by ERO, which had significantly contributed to the success of SEAMCAT, particularly, by the former staff member Mr. Tomas Cesky and the current member Mr. Darko Ratkaj.

Annex 1

Membership of the Memorandum of Understanding

on Development of Monte Carlo Simulation Tool

(August 2002)

Signatory	
Radiocommunications Agency	GB
Nortel Fixed Wireless Access	GB
Czech Telecommunications Office	CZ
France Telecom CNET/DMR/URF	F
Swisscom AG NWA-NOW-STFM	CH
Telecom Italia – DRE/IR – IAP	I
Deutsche Telekom AG, Technologiezentrum	D
Telecom Administration Center	FIN
National Telecom Agency	DK
National Post & Telecom Agency	S
Italian Administration	I
National Freqency Agency	F
Regulation Authority for Telecom and Post	D
ICP	P
BT – Spectrum management & Radio	GB
Matra Communications	F
ICO Services Ltd	GB
Ericsson Radio Systems AB	S
Norwegian Post & Telecom Authority	N
TRT Lucent Technologies	F
Federal Office for Communications	CH
TDF-C2R	F
Motorola - Paris	F
Radiocommunications Agency	NL
Croatian Institute for Telecomms & Post	HR
Nokia Research Center	FIN
Siemens Inform. and Comm. Networks SpA	I

Annex 2

SEAMCAT trademark registration

(28 February 2002)

SEAMCAT trademark registration has been successfully finalised in the following countries:

Country	Trademark owner	Date of renewal
International 'Protocol' China Cuba Czech Republic Estonia Hungary Island Latvia Liechtenstein Lithuania Moldova Monaco Norway Poland Romania Russia Slovak Republic Slovenia Switzerland Turkey Yugoslavia (Serbia and Monte Negro)	SEAMCAT MoU	06 September 2009
EU Member countries: Austria Belgium Denmark Finland France Germany Greece Ireland Italy Luxembourg Portugal Spain Sweden The Netherlands United Kingdom	SEAMCAT MoU	07 September 2009
Andorra	ERO	23 January 2011
Croatia	ERO	17 January 2011
Denmark	SEAMCAT MoU	01 March 2010
Malta	ERO	15 January 2011
Mexico	ERO	22 January 2011

Annex 3

Potential areas for further development of SEAMCAT

Item	Comments
Specification and implementation of algorithms for **CDMA** systems	
Specification and implementation of the **Limits Evaluation Engine** including the definition of system performance measures other than the probability of interference (e.g. capacity loss) and the development of the associated analytical capabilities	Optimisation algorithms for the Limits Evaluation Engine Enhanced Monte Carlo Analytical Model for CDMA system Comments on SMC(99)13rev1
Definition and implementation of a **sensitivity analysis** algorithm	Sensitivity analysis for the Monte Carlo tool
Development of analytical capabilities for the analysis of **space service** interference scenarios	Concept for NGSO and GSO satellites
Development of analytical capabilities for the analysis of **passive service** interference scenarios	
Identify suitable strategies to take into account the **active/passive rate of radio transmitters** (e.g. TDMA systems, duty cycles for SRD)	
Introduction of specific channel allocation schemes such as **frequency hopping** or **dynamic channel allocation**	
Inclusion of **topographical data base** including terrain height, land-usage and population data	

There is certain initial work already done for the first three topics.

Based on the experience gained with the various versions of SEAMCAT, the possible drawbacks should be overcome by introduction of improved elements. Some elements already identified are given in the following Table.

Topic
Different polarisation of antennas, particularly for Fixed Services
New structure of DEE for the stability of the random signals and inclusion of the determination of an interval of reliability in the ICE
Different, geographically separated areas for the wanted and interfering radio systems